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ABSTRACT

In the light of significant changes in contemporary society that demand high level thinking skills of professional workers, this monograph explores the nature of independent thinking and principles of teaching independent thinking, particularly to college freshmen. A section on independent thinking outlines abstract, creative, and systematic thinking and requirements for precise communication of thought processes. The next section discusses how unnatural the open-mindedness and uncertainty that independent thinking requires is to the human brain and argues that innate human thinking abilities require some restraint and shaping in order to acquire independent thinking skills. General principles of teaching independent thinking skills are outlined in the following section with the observation that, if independent thinking is somewhat unnatural to the human brain and its development, instructors may have to consider instructional approaches which are more directive and more demanding of teacher time and effort. Some pedagogical approaches suggested include requiring constant practice in the construction and use of abstract concepts and requiring a great deal of expository/argumentative writing. A section on programs to teach thinking skills reviews thinking-across-the-curriculum, thinking-across-the-college-school-divide, and faculty retraining approaches. A final section discusses teaching abstract thinking, creative thinking, systematic thinking, and the precise communication of thought to college freshmen, specifically. (Contains 32 references.) (JB)

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Monograph Series
Number 17

The Freshman Year
EXPERIENCE®

Beyond Critical Thinking

Teaching the Thinking Skills Necessary to Academic and Professional Success

By
William T. Daly

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University of South Carolina, 1995

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Introduction

by

John N. Gardner

I am greatly pleased to introduce Monograph #17, the latest in our series of topical monographs from the University of South Carolina's National Resource Center for the Freshman Year Experience and Students in Transition. I have known and respected the work of monograph author Bill Daly for a number of years. The collaboration of the Resource Center and Bill Daly represents the kind of symbiosis that must exist between researchers in the field and publishing resource centers across the country. In this symbiosis, the researcher/author is able to expose crucial findings, this Resource Center continues its record of bringing readers the best information to be had in this field, and the administrators, faculty, and students of higher education benefit immeasurably by the dissemination of the ideas presented by a monograph such as this one.

I first met Bill Daly in 1988 when I attended a conference at his school, The Richard Stockton College of New Jersey. I went to a session presented by a political science professor, Bill Daly, whose work I was not familiar with. His topic was critical thinking, and as he spoke I became more and more intrigued with what he was saying. I resolved to learn more about this professor of political science and about his ideas. In the short time hence, I have come to understand why Bill Daly is such a highly regarded senior faculty member at his school and why he was asked by his colleagues to head a state-level New Jersey task force on the development of critical thinking skills in college courses. This monograph is ample evidence of his scholarly acumen and originality.

This year, with a name change that added "Students in Transition" to our old title, the National Resource Center for The Freshman Year Experience, our mission has expanded in kind. Bill Daly's monograph is among the first that will be part of and is most compatible with this expanded mission. Daly argues, surely and convincingly, that the need to develop capacities for critical thinking skills in people entering college directly influences their ultimate employability—in short, do our first-year students develop during the college the kind of critical thinking skills they must have by the end of their senior year if they want a job? And, beyond this question, do first-year students each develop an individual, independent form of critical thinking? Indeed, our most sincere hope is that Daly's ideas as provided in this monograph will help move our colleagues

in the freshman year experience movement beyond focusing exclusively upon critical thinking to what Daly describes here as "independent thinking" —exactly the kind of evolution we need to see from the first year to the final year of the college experience.

On behalf of our Resource Center, I thank our friends on the staff of the *Journal of Developmental Education* at the National Center for Developmental Education at Appalachian State University for allowing us to publish Bill Daly's complete manuscript on this topic. *The Journal of Developmental Education* had published an abbreviated version of Daly's thesis in the Winter 1994 issue. We are most pleased to be able to present the full text of Daly's work for the readership of our monograph series.

We welcome your comments on this monograph, as does Bill Daly who works in the Department of Political Science at The Richard Stockton College of New Jersey, in Pomona, New Jersey.

Changes in the American and global economies will require college graduates who can go beyond critically analyzing the ideas of others to developing new ideas of their own. Those same economic changes have resulted in demands that college educators develop this capacity for independent thinking not only in that small group of honors students who may become scholars but also in that much larger group of average students who will become members of America's professional level workforce. The good news, then, is that the kind of thinking which has always been the key to academic success is increasingly valued by the external job market as well. The bad news is that there is increasing evidence, from research in the areas of collective behavior, cognitive psychology, and artificial intelligence, that many of the mental activities necessary for independent thinking run counter to the ways in which the unschooled human mind normally processes information. Those educators who seek to help their students meet the growing academic and economic demands for independent thinking skills will have to modify their instructional strategies in light of this new information on how the human brain actually works.

The human foot was not built for ballet. Only with discipline, training, and pain, can it endure the strain and produce beauty. The human mind was not built for independent thinking. Only with discipline, training, and pain, can it endure the strain and produce knowledge. Such at least is the conclusion which seems to be emerging from our unfolding knowledge of how the human mind actually works.

An understanding of the implications of this unsettling conclusion for educators first requires an understanding of the kind of thinking skills now being demanded not only by educators but also by business and political leaders. Second it requires an understanding of the growing evidence that much of this kind of thinking runs against the grain of that marvelous piece of mental equipment which our students, as members of the human species, bring from the primeval plain into our classrooms. Finally, it requires an unblinking look at the pedagogical implications of this evidence.

The Demand for Independent Thinking

The kind of thinking which is increasingly demanded of our students, both inside and outside of the academy, is *independent* thinking—thinking which will permit them to go beyond remembering the ideas of others to generating new ideas of their own. This is not, of course, a new goal for those inside the academy. Since the time of Socrates, it has been the cherished hope of most teachers that they might develop at least some students who could one day add something to the store of human knowledge themselves. And it has always been the collective responsibility of teachers in a democracy to help develop a thinking citizenry, capable of independently evaluating the pronouncements and performance of public officials.

Most of the push behind the current emphasis on thinking skills, however, is not coming from these traditional academic concerns. It is coming from members of the national business and political communities who are concerned about the international competitiveness of the American economy and hence about the education of the national workforce. Their public statements on education reflect their widely shared belief that Americans, in the future, will not make their collective living primarily as mass producers of standardized industrial products. Instead they will have to make it as a source of continuing innovation in technology and services. In such an economy, they suggest, we will have to pursue the *initial* profits and jobs associated with each innovation, watch most of the economic benefits from its long term production gradually migrate overseas where labor and materials are cheaper, and hence confront the need for an endless series of such innovations.

The educational requirements of this kind of economy will be fundamentally different from those of the assembly-line, industrial economy which has sustained American prosperity in the past. The success of this new kind of economy, they argue, will require the education of a larger professional level workforce and one with a substantial capacity for independent and innovative thinking (National Commission on Excellence in Education, 1983; Newman, 1985; Johnston & Packer, 1987).

The Components of Independent Thinking

For the classroom teacher, the practical meaning of this academic-economic convergence of opinion on the importance of independent thinking can best be understood by reviewing the kinds of instructional programs which have sprung up in response to it. In spite of variations in phraseology, most of these programs use a basic input-process-output model of thinking. That is to say that they focus on the way in which students take in information when they read and listen, what they do with it between their ears, and how they put it back out again in response to the demands of their teachers. Different programs focus on different parts of that three-part process, but viewed collectively, these instructional programs reflect considerable underlying consensus on the *kinds* of intake, process, and output skills which students must learn if they are to become *independent* thinkers (Nickerson, Perkins, & Smith, 1985; Chance, 1986; Baron & Sternberg, 1987).

Abstract Thinking

Abstract thinking refers to the intake part of the process and focuses on what students need to do when they read and listen in order to build the basis for independent thinking. Abstract thinking has been highlighted as a component of independent thinking primarily by "Piagetian" instructional programs, (i.e., those based on Jean Piaget's famous

distinction between "concrete" and "formal" thinking). What students most need, according to these theorists, is to move up a level of generality or abstraction from their instinctive tendency to memorize concrete bits and pieces of factual material in precisely the form in which they are initially presented.

Instead, students need to learn to abstract general concepts or principles from the welter of concrete detail, and then use those intellectual categories both to decide which specifics are worth keeping and recording and to summarize and organize what is kept. In this way, the construction and use of abstract concepts can reduce the formless tidal wave of new information which schooling seems to offer to intellectually manipulable chunks of raw material related to thinking about the question at hand.

Beyond simply helping students to *manage* information, this capacity to build and use general concepts and principles is also a direct prerequisite to the first limited form of independent thinking—the capacity of students to independently *apply* what they have learned in one context to related materials which they encounter later. Only if they can abstract general ideas and principles from the concrete materials learned in one context, will they be able to carry those general principles forward and apply them to an understanding of related materials which they subsequently encounter—in a later portion of the same class, in later classes, or in the world of work after they graduate (Flavell, 1971; Fuller & Associates, 1980).

For both these reasons abstract thinking is viewed as a crucial prerequisite to the next, more ambitious task—going beyond the management and application of others' ideas to create ideas of one's own. This is, of course, the most mysterious and prized component of independent thinking, and the second step of the input-process-output model used by most instructional programs in thinking skills.

Creative Thinking

Creative thinking refers to the "process" component of the three-step model, and focuses on what students need to do once they have extracted the information essential to their purpose and organized it under general concepts or principles. This central component of independent thinking has been highlighted primarily by an explosion of self-help books and instructional programs on "creativity" and "problem solving." What students most need to do, according to these theorists, is to overcome their instinctive tendency toward immediate closure around the simplest or most familiar approach to a question. They need, instead, to wait, to consider a variety of approaches, to arrange the chunks of relevant information developed in the first stage in a variety of

configurations–to give themselves, in short, the opportunity to see a new pattern, divine a new approach, generate a new idea.

No one pretends to know where creative insight comes from. But all of the instructional programs which pursue it seem to share the assumption that the appetite for immediate closure is its greatest enemy. And most of the instructional techniques these programs have devised are best understood as attempts to hold the mind open and march students through the consideration of a number of alternatives before permitting closure (Polya, 1957; Adams, 1986; Hayes, 1981).

Systematic Thinking

Systematic thinking refers to the output stage of the thinking process and focuses on what students need to do in order to elaborate on and validate any ideas generated by the first two stages. Systematic thinking is the central concern of the instructional programs which focus on formal or informal "logic." According to these theorists, students need to be able to determine what follows logically from their ideas and from the available evidence—whether they are writing an essay for an English class or exploring a scientific hypothesis.

This third component of the capacity for independent thought implies the ability and the willingness to subject all ideas, even the most fervently held ones, to the tests of logical coherence and, where appropriate, empirical evidence. It is important to the more general capacity for independent thought for two reasons. First, it permits students to *extend* their knowledge into new areas by determining what follows logically from things they already know. Secondly, it permits them to *validate* their developing knowledge by constantly checking it for logical consistency and factual support (Beardsly, 1975; Cederblom & Paulsen, 1982; Walton, 1990).

Precise Communication of Thought

In many models of the thinking process, this third output step is extended to include the ability to communicate the products of one's thinking to others. This ability is the central concern of the instructional programs which focus on the relationships between language and thought. According to these theorists, students need to be able to communicate their thoughts not only orally but in writing. And they need to write with sufficient precision to be intelligible and persuasive not only to friends and teachers but also to audiences which are more distant, diverse, and skeptical. Writing is emphasized in many thinking-oriented instructional programs both because of the belief that the writing process itself clarifies thought and because it is essential to the process by which the knowledge is shared and becomes cumulative (Gregg & Steinberg, 1980; Maimon, Nodine, & O'Conner, 1988).

Independent Thinking as an Unnatural Act

Human thinking is doubtlessly a much more continuous and non-sequential process than this tidy, three-step model implies. But it does provide a useful summary of the potentially teachable subcomponents of the capacity for independent thought from the point of view of those who have had the most experience in actually trying to develop that capacity in students. What is immediately striking about these elements of independent thinking, however, is the amount of open-mindedness and uncertainty that they would collectively require students to endure.

To become *abstract* thinkers, students must learn that reality and the "facts" should not be simply accepted as the way things are, but rather must be sifted and selected, arranged and rearranged under abstract concepts. And those organizing concepts themselves are not to be viewed as direct outgrowths of a stable reality, but as free-floating devices for configuring information, with the best configuration depending on one's purpose.

Once students have selected and organized relevant information, they must learn, as nascent *creative* thinkers, to resist the temptation to come to quick conclusions until a variety of possible interpretations and conclusions have been examined. And finally, to become *systematic* thinkers, they must come to understand that no conclusions, no matter how carefully drawn, are ever final. All beliefs, no matter how securely and dearly held, must be continuously subjected to the tests of logic and evidence.

This is a scholar's mind set, an entirely appropriate educational objective if one's goal is to train students who, like scholars, will be able to produce new knowledge on their own. But, because of economic changes discussed at the beginning of this essay, teachers are now being asked to develop this mind set, not in a handful of their best students, nascent scholars all, but in all or at least most of the future members of the professional workforce. This growing tendency toward making the capacity for independent thought a goal of mass education may be entirely laudable. It may even be achievable. But our selection of methods for pursuing this goal must at least be informed by the growing evidence, from our unfolding knowledge of how the human mind works, that most human beings may find it very difficult to sustain the degree of open-mindedness and perpetual uncertainty implied by this scholar's definition of independent thinking.

The observation that human behavior, in the aggregate, is often closed-minded and irrational has been commonplace since the earliest recorded reflections on the human condition. But three sets of relatively recent scholarly investigations have not only documented this tendency toward closed-mindedness but have also raised the possibility that it may be a

tendency deeply rooted in the nature of the species–an inherent and formidable obstacle, the strength of which must be fully understood by those of us who seek to develop the capacity for independent thought in the classroom.

This bad news has arrived in three waves. All have been largely unheralded in educational circles. But each has peeled back another layer of the mysteries surrounding the miracle of the human mind.

Collective Behavior

The first unsettling news about the capacity of most people to sustain the open-mindedness and uncertainty associated with independent thinking emerged from analyses of the initial human impact of two ideas which have been central to the growth of knowledge and wealth in Western societies–science and materialism. These ideas had become the dominant modes of thought in industrialized Europe by the 19th century and swept through the rest of the world with European colonialism in the early 20th century.

Science and materialism have achieved and continue to achieve enormous successes in the production of new knowledge and wealth. But, like the current conceptions of independent thinking for which they are models, they also require the acceptance of a great deal of open-mindedness and uncertainty. Because science believes in the reality of only physically observable things or things that have physically observable effects, it must constantly revise its view of reality in light of new evidence. As a result, it is, ideally at least, perpetually distrustful of all absolutes and certainties, whether they are grounded in religion or in yesterday's scientific orthodoxy. Materialism, the derivative tendency to measure success and human worth primarily in terms of the accumulation of physically observable things, is similarly distrustful of all comforting claims to lifelong status and worth, whether they are based on bloodlines or on yesterday's economic successes.

As a result of this perpetually questioning attitude, the spread of science and materialism could be viewed, and often has been viewed, as the beginning of a global victory for intellectual emancipation and open-mindedness. But that same open-mindedness wreaked havoc on pre-existing social structures, first in Europe and then in the lands the Europeans colonized, as well as on the sense of security of the people who lived though these changes. This, at least, is the common theme which ties together the classic analyses of the transformation of Europe under the impact of these ideas in the 18th and 19th centuries and the studies of the "modernization" of the non-Western world under the impact of European colonialism in the 20th century (Nisbet, 1966; Redfield, 1953; Doob, 1960).

Analyses of the massive popular support for the very closed-minded Communist, Fascist, and Nationalist movements which grew out of the impact of these ideas indicated that much of their mass appeal lay precisely in the sense of certainty provided by their comprehensive and close-minded ideologies. Popular support for Fascist movements, in spite of their explicit opposition to both political and intellectual freedom, was particularly disquieting (Fromm, 1941; Hoffer, 1951; Almond, 1954).

Finally, when social psychologists extended the analysis by examining an even wider variety of situations in which traditional constraints on behavior were suddenly broken down, they came to similarly disheartening conclusions. Most people responded to the resulting uncertainty not with a celebration of their new-found intellectual freedom, but with a frantic attempt to restore certainty and reduce open-mindedness by adopting the *most* simplistic and close-minded dogma currently available on the local marketplace of ideas (Smelser, 1963; Cantril, 1963).

These discoveries led a whole generation of previously optimistic scholars to raise serious questions about the amount of open-mindedness and resultant uncertainty the average individual could tolerate and to question the prospects for intellectual freedom and for democratic forms of government more generally. But all of these studies related, after all, to collective human behavior in times of crisis. It fell to more recent work in cognitive psychology to examine the open-mindedness of individuals in more secure and controlled settings.

Individual Behavior

The relevant studies in cognitive psychology took the form of a variety of experiments which attempted to determine how "logical" or "rational" human behavior is. While there is little unanimity on any of the issues surrounding this question, it is perhaps a fair summary of the weight of evidence to say that the everyday thinking of the untrained mind, as monitored during these experiments, had little in common with that of the logician or with the ideal model of the independent thinker delineated above and pursued by most instructional programs in thinking skills.

Most of us apparently approach the world of experience not with an open mind but with a set of mental stereotypes or preconceptions, variously called "schema," "models," "prototypes," "scripts," etc. Those preconceptions shape our very perceptions of reality by directing us to focus our attention on particular features within the welter of information taken in by our senses and to ignore others. They affect our mind's categorization of each new object or experience by type, the way in which it is stored as a memory, and the way in which that information will be reconstructed when it is recalled from memory at a later time.

As a result, the informal or everyday reasoning of most subjects in these experiments diverged, in ways that will be recognizable to any experienced teacher, from the ideal model of the abstract, creative, and systematic thinker delineated above. The concepts they used to organize new information were usually not free floating, high level abstractions consciously selected to organize that information for a particular purpose. They were more often products of concrete personal experience which the subjects viewed as an integral part of the reality they were interpreting. Their interpretations of information or situations were usually intuitive and almost instantaneous, and not the product of a deliberate review of a variety of possible interpretations. And those interpretations were usually elaborated and validated, not by logical deduction from the available evidence, but by a rough and largely unconscious comparison of the current information or situation with a mental model based on similar previous experiences.

Finally, when there was a conflict between what followed logically from existing evidence on the one hand, and what the subjects believed based on strongly held preconceptions on the other, they usually ignored the evidence and logic and stayed with their preconceptions. They seemed to be particularly immune to the statistical evidence based on a large number of cases which is so central to scientific investigation. All of these patterns will be distressingly familiar as typical student behavior to most experienced classroom teachers (Mayer, 1983; Newell, 1990; Nisbet & Ross, 1980; Kahneman, Slovic, & Tversky, 1982).

The Human Brain

Some of the answers to the question of why the unschooled mind operates in the ways noted by these students of collective behavior and cognitive psychology are now being sought by attempts to understand how the human brain works as a physiological mechanism. This is the province of "cognitive science," an interdisciplinary effort usually based on the root disciplines of philosophy, linguistics, cognitive psychology, neuroscience from biology, and artificial intelligence from computer science.

Artificial intelligence research, the attempt to build computers which will do what the human mind does, is particularly relevant to our concerns, precisely because of the great difficulty it has encountered in attempting to duplicate the human brain as a "logic machine." Digital computers are in fact logic machines with many of the same operating characteristics as the model of the abstract, creative, and systematic thinker delineated at the beginning of this essay and pursued as an educational goal by most instructional programs in thinking skills. The general concepts under which information is grouped, stored, and retrieved are consciously chosen with a particular range of purposes in mind. The computer can arrange and rearrange that information in a variety of configurations as a way of helping both to generate and test a variety of hypotheses. And it does all of these

things in accordance with a set of rules which are explicit, unambiguous, and tightly logical.

The great difficulty which has been encountered in programming digital computers to do a number of things which even a child's mind can do easily and almost unconsciously (e.g., recognize faces, understand and respond to natural language, find its way around a room, etc.) has led some researchers to conclude that the unschooled human brain does not function primarily as a logical mechanism. They propose instead a "neural network" or "connectionist" model of how the brain works which differs, at each of the three stages of the thinking process, from the more logical model of the independent thinker which I have abstracted from the instructional literature and delineated above.

First, according to this model, the raw materials with which the brain works are holistic, real-world experiences, not discrete and carefully cataloged bits of information together with a set of abstract logical rules for manipulating that information. Specifically, those experiences are represented in the brain as patterns of excitation along the networks of neurons of which the brain is composed. The myriad of unconscious, life-sustaining activities managed by the brain, and possibly even such foundations of conscious thought as basic concepts of space, time, and language, may be genetically wired into the brain at birth. But the portion of the brain which carries out conscious thought has many more neurons and many more potential neural networks than it will need. The ultimate configuration of that portion of the brain, according to the connectionists, is quite literally left to be shaped by real world experience. Specifically, patterns of neural connections which are related to experiences which occur frequently and to reactions to those experiences which "work" are physiologically strengthened by experience, while other, less used and less useful, patterns of connections atrophy.

Thus when we confront new information or situations, we do not consider a range of alternative interpretations and reactions on an equal footing, as the second stage in the ideal model of an independent thinker implies we should. Our interpretations and reactions are shaped not only by the objective characteristics of the information or situation, but also by the relative strength of the neural connections produced by past experience. One theorist contrasts a digital computer/independent thinker brain deciding on a response by serially reading the relevant portions of all of the books in its memory library, with a connectionist brain in which all of those books simultaneously shout competing interpretations/responses and the brain selects the loudest (i.e., the most familiar).

Third, when the available information is incomplete or ambiguous, as it almost always is (e.g., a familiar face with a different expression, a familiar sentence spoken with a different inflection or accent), the connectionist brain simply "fills in the blanks"–not based on careful logical extrapolation

from existing evidence, but based on models already built into the brain by past experience. It approximates, takes an educated guess–instantly, unconsciously and sometimes, as a result, inaccurately. Finally, communication of thought to others is predominantly spoken and often similarly imprecise. It relies on the ability of the listener, who often has a considerable backlog of experience with the speaker, to fill in the blanks (Gardner, 1987; Campbell, 1989; Edelman, 1992; Minsky, 1985).

Our knowledge of how the brain works is still very primitive, and the connectionist model just delineated is only one theory. But it does have the advantage of explaining some of the difficulties–already noted in the studies of collective behavior, cognitive psychology, and artificial intelligence–which humans seem to have with the open-mindedness and uncertainty necessary to independent thinking. Specifically, if our preconceptions come to be rooted in the very pathways of the brain, it is not surprising, as the students of collective behavior have discovered, that we cling to them tenaciously, that we panic when they become unusable for coping with radically changed circumstances, and that we then frantically seek the simplest available substitute framework that will help us to make sense of our world.

Similarly, the idea that such preconceptions are essential to the way the human brain makes sense of what would otherwise be an unintelligible welter of sensory information also helps to make sense of the power of those preconceptions, as discovered by cognitive psychologists, and of their tendency to overpower statistical evidence and logical deduction in the everyday reasoning of individuals.

Finally, the idea that the human brain uses models based on past experience to simply fill in the blanks, when confronted with incomplete or ambiguous information, helps to explain the findings of artificial intelligence research that the brain is generally superior to the digital computer in making approximate, common-sense judgements, but inferior with respect to activities such as mathematical calculations which require manipulation of information in strict accordance with logical rules.

Most important for our purposes, however, the connectionist model of the brain helps to explain some striking disparities in student performance which are familiar to most experienced classroom teachers. Most physiologically unimpaired students do not *speak* gibberish in discussing everyday concerns. Whether or not we approve of their diction or the content of their thoughts, they are intelligible, and even seem to make some sense logically. Many of those same students do, however, *write* gibberish in their academic assignments. This is particularly true when those academic assignments require them to grasp and order large amounts of information distant from their personal experience, to consider alternative interpretations of that information, to support their conclusions by logical inference

from available evidence, and hence to function as apprentice independent thinkers. If the connectionist theory is accurate, the human brain may have been wired by evolution to do the first set of tasks easily, but must be trained by educators to do the second.

Summary: Action versus Knowledge

The findings, summarized above, from the study of collective behavior, cognitive psychology, artificial intelligence, and practical classroom experience, are all compatible with the notion that the human brain was shaped by evolution primarily as a mechanism, not for contemplation, but for rapid reaction to an often dangerous world. As a result, it is at its awesome and effortless best in sizing up real-world situations, reacting to them almost instantaneously, and doing both by filling in the blanks in the inevitably incomplete and ambiguous information about the present with patterns from past experience. For the same reason, it is also best equipped for communicating with others in spoken language, which is similarly quick, incomplete, and ambiguous.

The intellectual capacities which we seek to develop in our students in the academic environment grow out of these innate human abilities but also require some restraint and shaping of the impulses which they produce. Our goal is not to enhance our students' capacity for rapid-fire reaction, but to enhance their capacity for contemplation and the generation of knowledge. And that will require restraining and disciplining many of the habits of mind which the process of evolution has carried from the primeval plain into our classrooms.

It will require developing in students the abilities to sift through and organize large amounts of information with which they have no direct personal experience, to delay their impulse toward immediate closure until a variety of interpretations have been explored, and to subject their conclusions to the tests of logic and evidence continuously. Finally it will require the ability to communicate their ideas, in writing, with sufficient precision to be intelligible and persuasive to audiences which are distant, diverse, and skeptical.

The historical advance of human knowledge makes it clear that at least some humans, and perhaps many of our students as well, can master this second, "academic" kind of thinking. But the understanding that the effort to do so is "unnatural," in the sense that it runs against the grain of the unschooled mind, must inform and shape the pedagogical techniques we use to pursue this goal.

Moving from the most general to the most specific, we turn now to the pedagogical implications of the above argument, at three levels: general principles, program structure, and classroom teaching techniques.

Teaching Independent Thinking: Some General Principles

If independent thinking is unnatural in the ways described above for most of us, then our students are unlikely to develop the capacity for it spontaneously—even if we take great care to remove all pedagogical obstacles to that development. We may have to *require* them to practice the requisite underlying skills over and over and over again.

This conclusion runs counter to an assumption, implicit in many thinking-oriented instructional programs, that children are spontaneously open-minded and creative until the educational system transforms them into closed-minded and unimaginative drones. Given this latter assumption, the central task of thinking-oriented instruction becomes the removal of artificial obstacles to what would otherwise be the students' natural development toward independent thinking.

If the argument put forward in this essay is correct, however, such natural, spontaneous development is more likely to produce thinking which is (a) concrete and personalized rather than abstract, (b) impulsive and conformist rather than considered and open-minded, and (c) strongly averse to potentially painful contact with the demanding rules of logic and evidence. If the argument put forward in this essay is correct, those of us who work in the classroom may have to work *against* the grain of what is natural and spontaneous in our students. To do that effectively, we may have to consider seriously some approaches to instruction which are both more directive with respect to students and more demanding of teacher time and effort than we might like. A review of the abstract, creative, systematic, and precise thinking, delineated above as the essential underpinnings of the capacity for independent thought, produces the following list of pedagogical implications.

Teaching Abstract Thinking

We may have to require constant practice in the construction and use of abstract concepts. And this should probably include not only more practice in the selection, organization, and manipulation of data generally, but also more work in the discipline most centrally concerned with the manipulation of abstract concepts—mathematics.

State and national test scores have consistently confirmed what students have been saying for generations—that math, for most of them, is "harder" than other subjects. If the human brain evolved as a device which derives abstractions or generalizations primarily from a series of direct personal experiences, it is not surprising that most of us have considerable difficulty in constructing and manipulating abstract concepts which are more distant from such concrete experiences or which, in the case of mathematics, may have no immediate concrete referents whatever.

To help our students rise above their natural tendency to think only in concrete terms, we may have to accept the resource costs, and the teacher and student travail, which will be involved in an attempt to make all our students at least competent in basic quantitative reasoning.

Teaching Creative Thinking

We may have to construct our courses in such a way that students who wish to pass them have no choice but to create at least some ideas of their own—rather than simply demonstrating an understanding of the ideas we give them.

If the human brain evolved primarily as a mechanism for providing instantaneous responses to a dangerous environment, it is not surprising that our students instinctively favor immediate closure around the most readily available approach or answer to any given question. They seize upon any idea offered by the teacher or text rather than undergo the protracted uncertainty and the painstaking consideration of alternative approaches which would give them their best chance for creating a novel idea of their own.

To overcome this natural appetite for immediate closure, we may have to turn to those admittedly difficult and time-consuming pedagogies which are designed to initially deny students any authorized "right" answer and hence force them to fashion ideas of their own. Examples of this kind of approach include Socratic questioning, in which the teacher offers questions rather than answers, and "discovery" learning, in which the teacher provides a series of concrete experiences or experiments from which the students must derive general principles for themselves. Students who require more structure than such open-ended pedagogies provide might benefit from a "multiple perspectives" approach, in which the teacher presents a range of conflicting approaches or interpretations on each topic and requires the students to evaluate the relative merits of those approaches en route to constructing and defending views of their own.

Teaching Systematic Thinking

We may have to insist that our students practice systematic thinking by consistently requiring them to explain and justify their work logically and in terms of the available evidence. We have already discussed the argument that the human brain did not evolve as the kind of "logic machine" represented most clearly by digital computers, but as an organ which responds instantly to perpetually incomplete information from the environment by simply "filling in the blanks" based on past experience. If that is so, it is not surprising that our students are disinclined to subject their ideas to the painstaking and potentially corrosive tests of logic and evidence.

If we want them to develop this important but unnatural habit of mind, we may have to balance our legitimate efforts to build student "self esteem" (by trying to find *something* of value in *all* of their efforts) with a consistent demand that their ideas must ultimately stand the tests of logic and evidence. Even in areas (most of them) where there are a number of legitimate interpretations, we may have to impose some outside limits on our compassionate inclination to say, "that's an interesting idea." Instead, we may have to join more often with a crusty old English teacher of my acquaintance in saying, "It is true, Mr. Daly, that there are a number of reasonable interpretations of this poem. Unfortunately, yours is *not* one of them."

Teaching Precision in the Communication of Thought

If we want students to be able to express their ideas with sufficient precision to be intelligible and persuasive to a variety of audiences, we may have to require them to do a good deal more writing, and, in particular, a good deal more expository/argumentative writing than most of them currently do. While the exact nature of the process is still very much in doubt, it is clear that the enormously complicated task of acquiring a spoken language seems to come easily and naturally to most humans. In addition, our students are aided in face-to-face spoken communication by such factors as inflection, facial and physical gestures, the opportunity for mid-course corrections and elaborations, and the frequent familiarity of the listener with the thinking of the speaker even before she or he speaks. Perhaps the central reason why spoken communication seems to come so naturally and easily to our students is that the above factors create in the listener a considerable capacity to "fill in the blanks" even in this inevitably incomplete and ambiguous mode of communication.

As any experienced classroom teacher can attest, however, written communication is not nearly so natural for most students. There, the message must be much more complete and precise in the text, because the audience may not be personally familiar with the thinking of the writer, may lack any of the interactive aids available in face-to-face communication, and therefore may have a much more limited capacity to fill in the blanks.

The problem is compounded when students move from descriptive or narrative writing based on personal experience to the kind of expository writing which is central to success in academic and in professional level work. Expository writing and argumentation often require the manipulation of information distant from the writer's direct personal experience. They also require skill in the use of logic and evidence. And both those sets of skills, as already noted, may come naturally to neither the writer nor the reader.

As a result, if we are to overcome our students' natural preference for oral communication and help them to develop the much more difficult skill of effective expository writing, we will have to require them to do lots of it. And we will have to be willing not only to grade their efforts but also to comment on the specific strengths and weaknesses of their work—quickly, repeatedly, and in detail.

Testing for Independent Thinking

Finally, the development of our students as independent thinkers will probably require us to reduce our reliance on multiple-choice testing and the instructional practices keyed to it, in favor of assessment methods which evaluate and reward the full range of the thinking activities necessary to independent thinking.

The central problem with multiple-choice testing, as a way of measuring and rewarding independent thinking, is that it can effectively measure only one of the four elements discussed in this essay.

The time limitations on most multiple-choice tests preclude any assessment of abstract thinking—the construction of abstract concepts and their use to cull, organize, and manipulate large amounts of information. Similarly, the need for a single, predetermined right answer precludes any assessment of the capacity for creative or novel thinking which, by definition, might produce an answer unanticipated by the test makers. Finally, the use of prepackaged answers and machine-scorable answer sheets precludes any assessment of the capacity for the precise written expression of thought.

The multiple-choice format is, of course, well adapted to measure the recall of specific information. But, with respect to the elements of independent thinking, it is well adapted to measure only the third element of such thinking—systematic or logical thinking—because it is the only element which produces something approaching the single right answer which the multiple-choice format requires.

The same tendency to truncate the thinking process at both ends is characteristic of teaching methods used to prepare students for multiple-choice tests. Drill in standard math problems asks students only to recognize and apply the appropriate logically deductive steps to solve problems which have already been selected and set up for them. They are not required to select the critical elements of a real-world situation, and translate them into a mathematical representation of the problem, before carrying out the mathematical procedures on which they are being drilled. Nor are they normally required to reapply their answer back to that real-world problem, check it for reasonableness and usefulness, and explain it verbally to others.

Similarly, in the verbal area, standard courses in logic frequently focus on evaluating the logical coherence of an argument or series of statements constructed by *someone else*. As a result, students receive no training in the identification of questions worthy of investigation, in selecting and organizing relevant information, or in initially formulating a viewpoint which can then be subjected to the rules of logic and evidence. Nor, at the other end of the thinking process, do they receive any training in presenting and defending that view to others.

In spite of these weaknesses, the use of multiple-choice testing continues to expand rapidly, not only in the classroom but also in the state and national testing programs born of demands for greater educational "accountability." This popularity is based, of course, on the time, effort, and cost efficiency of multiple-choice tests as a method for evaluating large numbers of students. It is also based on the capacity of such tests to generate "objective" scores which are convenient for ranking the performance of individual students or groups of students.

But if independent thinking is as difficult and frightening for most students as this essay argues, we may have to employ a full set of rewards and punishments to induce students to make the requisite effort. And that will almost certainly require some movement away from the convenience of multiple-choice testing toward evaluation and grading systems which actually measure and reward the difficult skills we want our students to develop.

Teaching Independent Thinking: The Structure of Thinking Skill Programs

Such are some of the general pedagogical implications of the argument that independent thinking is an unnatural act. At a more concrete level, there are also implications for those who seek to construct institutional programs for teaching thinking skills.

Thinking Across the Curriculum

Effective institutional efforts to develop the capacity for independent thought will probably have to involve thinking-oriented instruction across content areas. If independent thinking does run against the grain of our students' natural inclinations, they are likely to develop skill in this special way of thinking only if they confront the demand for it, and help in meeting that demand, in most, or at least in many, of the classes they take.

This implies that educational institutions cannot rely solely on the creation of a few special classes in thinking skills. Effective programs will probably require participation by faculty from across the

curriculum. More specifically, success may require a collective faculty effort to change the *way* we teach many of our content courses—so that students regularly practice thinking skills at the same time as they develop content mastery.

For example, such a thinking-across-the-curriculum approach might ideally require students, for *each* major topic which a regular content course covers, to (a) use general concepts to select and organize the available information, (b) construct ideas of their own, (c) support those ideas logically and with available evidence, and (d) express the results of this thought process effectively in writing.

Thinking Across the College-School Divide

Effective instructional efforts to develop the capacity for independent thinking should probably involve thinking-oriented instruction across class levels within college and, if possible, cooperative efforts between colleges, on the one hand, and elementary and secondary schools on the other. The difficulty of changing established ways of thinking has long been noted in folk wisdom and documented by psychological experiments. More recently, as already noted, the "connectionist" theory of the brain has raised the possibility that the strength of such predispositions derives from the fact that they become rooted, by experience and practice, in the physiology of the brain itself. All of this would seem to suggest that attempts to develop the capacity for independent thought will have a much better chance of success if they are undertaken as early in a student's development as possible and regularly reinforced thereafter.

Some of that collaborative effort between colleges and the schools to emphasize thinking skills in pre-collegiate instruction should, of course, be devoted directly to classroom techniques for helping students develop the capacity for independent thinking. (Examples of such techniques are discussed in the following section.) But, paradoxically, some of the effort should also be devoted to content instruction and, in particular, to providing teachers with continuous content updating in the exploding knowledge areas in which they teach.

Most college faculty have had extensive graduate level training in the areas in which they teach, and their classroom workload is structured on the assumption that they will need a good deal of free, non-classroom time to remain current in those areas. Most elementary and secondary teachers do not enjoy those advantages. In order to meet shifting district needs, they are often assigned to teach subjects in which they have had little formal training. Most of their working hours are committed to the classroom or to other assigned duties, and many of them have to work at a second job during the summers to make ends meet. They are tightly tied to textbooks which are necessar-

ily two to three years out of date when they are first published, and many more years out of date than that before they can be replaced. And they have neither the time in their schedules nor the funding to pursue ongoing professional development.

At the same time, the rate at which knowledge is generated and the rate at which it becomes obsolete is rapidly accelerating in most of the areas in which they teach. And those changes in the knowledge base frequently imply, not simply the addition of new material, but a fundamental transformation of the ways whole areas of the curriculum should be understood and taught. That is certainly true—even at the level of pre-collegiate instruction—for the life sciences as a result of developments in molecular genetics, for the physical sciences as a result of new discoveries about the structure of matter and of the universe, and for social studies as the result of the increasing globalization of everything that really matters.

If college officials seek greater pre-collegiate emphasis on thinking skills, they need to recognize that the inability of many school teachers to remain confident and current in the subjects they teach impoverishes not only the content of what they teach but also their teaching methods. The consensual lament of most of the recent reports on pre-collegiate education about the dominance of memorization and the absence of the more active exploratory teaching techniques necessary to develop the capacity for independent thinking can be addressed only partially by additional training in thinking-oriented teaching techniques. It must also be addressed by helping teachers to build and maintain their status as genuine, up-to-date experts in the content areas in which they teach. Only that will give them the classroom authority and self-confidence necessary to free them from a desperate dependence on the textbook and teacher's guide, and to embolden them to use some of the more risky, exploratory teaching methods necessary to thinking-oriented instruction.

Adding this kind of continuous content updating to work on thinking-oriented teaching techniques is not as tall an order as it might seem initially. The ongoing review, aggregation, and interpretation of the latest research findings in one's field, in pursuit of materials of sufficient long-term significance to justify their inclusion in an undergraduate course, has always been central to course preparation for the best undergraduate teachers. What is suggested here is simply the delivery of those materials to a new audience of school teachers. Such an effort would both benefit the teachers and the quality of instruction they offer, and improve the level of thinking skills among entering college freshman. It might also give visibility to the often invisible process of undergraduate course preparation so that this process will be accorded more weight in the evaluation and reward of college faculty.

Faculty Retraining

If an effective thinking skills program will require an effort across the curriculum and across grade levels, it will also require substantial faculty retraining—of three kinds. The first necessary effort is definitional. Most faculty can and do themselves think in the way described in this essay. In talking about "thinking skills," "independent thinking," or "critical thinking," we have in fact coined a phrase for the kind of thinking which has always been central to Western academic institutions. Most college faculty have been immersed in it most of their professional lives, most have learned by long practice to do it intuitively and automatically, and most recognize the capacity to do it as the central distinguishing characteristic which separates good students from poor students. But most faculty have not thought carefully about the potentially teachable components of the capacity for independent thinking. Any institutional effort to develop an emphasis on thinking skills, therefore, will probably have to begin with faculty discussions of what those components are.

Secondly, I have argued above that most students will find independent thinking so difficult and frightening that they will develop the skills necessary to do it only if they are regularly confronted with both the demand to do so and assistance in doing so. If that is true, an effective thinking skills effort will require faculty participation from most of the college's curricular areas. Such participation will require, as a second step, faculty discussions of the similarities and differences in the thought processes necessary for independent work in such major curricular areas as the natural sciences, the humanities, and the social sciences—along with discussions of how to help students improve the thinking skills which are critical for work in those various content areas.

Finally, I have argued that pedagogical change in general, and the more exploratory instructional techniques necessary to developing thinking skills in particular, are likely to be undertaken only by instructors with a good deal of confidence in their content mastery. If that is so, it would argue for a thinking-oriented reworking of courses initiated by the institution's best instructors in their best subjects and disseminated to other instructors in all subject areas.

Teaching Independent Thinking to College Freshmen

This review of the recent research relevant to thinking skills instruction carries three implications for freshman-year programs. First, the set of thinking skills described in this essay as essential to the capacity for independent thinking are best understood not as *one* of the sets of skills which college students need to develop but as *the* way of thinking which is central to Western educational institutions and to academic success within them. The development of these skills is, as a result, an appropriate

emphasis for all freshmen, and for the freshman year programs which seek to improve their chances for academic success.

Second, because independent thinking runs against the grain of how the unschooled mind normally processes information, most entering college students will find this way of thinking difficult and frightening. As a result, it is entirely appropriate that training in independent thinking should begin as soon as possible, in the freshman year if not in pre-collegiate education, and should continue throughout a student's college education.

Finally, because this way of thinking is difficult, students will be inclined to engage in it only if they cannot escape the need to do so. It is important, therefore, to imbed repeated work on these skills in academic tasks which students must do repeatedly. One way to accomplish this is to structure the *study skills* which are emphasized in many freshman year programs, and which students must apply in all their classes in such a way as to transform them into preliminary training in the basic components of independent thinking. Some examples follow of how that might be done for each of the components of independent thinking around which this analysis has been built.

Teaching Abstract Thinking

Teaching students the essential study skill of taking usable reading notes can be readily transformed into practice in abstract thinking. Specifically, it can help students to learn how to use abstract concepts to select essential information and organize it into the manipulable chunks of intellectual raw material necessary for independent thinking. For example, accompanying all reading assignments with guide questions which tell students what you expect them to extract from the reading will provide them with abstract concepts (intellectual cubby holes) which they can use to select which material to keep and to organize what is kept.

Insisting that they prepare written summary answers to each question, expressed in their own words, will force them up a level of abstraction from the mindless memorization of randomly selected bits and pieces of textual material. And enforcing both of the above requirements with regular and graded oral quizzes will bolster student motivation to carry out these difficult tasks—not only with grade pressure but also with the even more powerful concern about public approval or embarrassment which is attached to required oral responses in a classroom setting.

Teaching Creative Thinking

Students can be tutored in the open-mindedness necessary to creative thinking at the same time as they practice writing short essays. For

example, the topics for these essays could be presented in the form of controversial issues, with the instructor presenting two or more conflicting viewpoints on each issue. Students could then be asked to use their essays to evaluate those conflicting viewpoints and to construct one of their own. Students who take the easy way out by simply adopting one of the viewpoints presented by the instructor could be required to explain why it is superior to the viewpoints which they did not adopt. In this way students would begin to practice the difficult and frightening business of generating at least some ideas of their own as a part of every essay they write.

Teaching Systematic Thinking

Once students have developed a central idea or thesis statement from the above effort, they could be tutored in the skill of logical deduction by means of the instructor's early, oral intervention into the writing process. Specifically, student thesis statements or rough outlines could be discussed orally by the instructor either in class or in the office before the essay itself is written. In this way students could be assisted in the logical development of their ideas while operating in the realm of oral expression where most of them are more competent (for reasons discussed above) than they are in the realm of written expression. Helping students to construct an improved outline immediately after that discussion might then help them to transfer the logical skills that they do possess in the realm of spoken communication directly into the more difficult realm of written communication.

Teaching the Precise Communication of Thought

Most of us who have been teaching for a while have developed relatively time efficient methods for noting the mechanical defects in student writing. Commenting on the degree to which that writing reflects independent thinking (the selection and ordering of available information, the generation of interesting and plausible ideas, and the use of logical analysis and evidence to support those ideas) is much more difficult. There is not enough space for such commentary in the margins. And the alternative of detailed written commentary on student papers is generally too time consuming for the instructor and is unlikely to be read by the students.

However, commenting on student writing on audio tape cassettes, rather like a pathologist performing an autopsy, might combine the kind of detailed commentary which is necessary for student improvement with a manageable expenditure of faculty time. Such taped comments, moreover, can be delivered in a more personal and emotive way, with the result that students might take them much more to heart.

A Closing Caveat

A model of independent thinking which surrounds the element of creative thinking with other more convergent elements (using abstract concepts to order information, subjecting ideas to the tests of logic and evidence, and communicating ideas by means of expository writing) will probably strike some as arguing for an unduly cold-blooded and rational model of the ideal student. It is fair to say that the model presented in this essay is probably more appropriate to the natural sciences and some of the social sciences, with their emphasis on objectivity, than it is to the arts and some of the humanities. It is equally fair to say therefore that developing the capacity to think in this particular way is certainly not the *only* thing that American educators need to do for their students.

But both tradition-oriented and market-oriented academics should be able to agree that this is *one* of the most important capacities which we should help our students to develop. This way of thinking has been, after all, a central element of the Western intellectual tradition since classical Greece. And, as noted briefly at the beginning of this essay, it is now sought with a growing sense of urgency by many of the potential employers of our students as a result of emerging changes in the American and global economies.

The central argument of this essay is simply that those of us who choose to pursue this important educational goal, for any of the above reasons, must adapt our teaching methods to the emerging evidence that we will have to overcome something no less fundamental than the way in which the unschooled human mind normally processes information. The classic line from the *Pogo* comic strip should shape both our expectations and our instructional strategies: "We have met the enemy, and they are us."

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These references are designed as an introduction, for the non-specialist, to the sizable bodies of specialized literature surveyed in this essay. As a result, they are limited to works which either are overviews themselves or are representative or influential examples of a particular body of literature.

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